



THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of :
Sheng Mei SHEN et al. :
Serial No.: 10/781,616 : Group Art Unit 2625
Filed February 20, 2004 : Attorney Docket No. 2004_0267
IMAGE PREDICTIVE CODING METHOD

VERIFICATION OF ENGLISH TRANSLATION

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Sir:

I, Kazuhiko YASUI of c/o Aoyama & Partners, IMP Building, 1-3-7, Shiromi, Chuo-ku, Osaka 540-0001 Japan, declare that I am conversant in both the Japanese and English languages and that the English translation as attached hereto is an accurate translation of Japanese Patent Application No. P8-132970 filed on May 28, 1996.

February 12, 2008

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PATENT OFFICE
JAPANESE GOVERNMENT

This is to certify that the annexed is a true copy of
the following application as filed with this Office.

Date of Application: May 28, 1996

Application Number: Patent Application No. P8-132970

Applicant(s): Matsushita Electric Industrial Co., Ltd.

Commissioner,
Patent Office

June 20, 1997
Hisamitsu ARAI
(seal)

Document Name: Application for Patent
Docket No.: 2022580252
Date of Application: May 28, 1996
Addressee: Commissioner, Patent Office
International Patent Classification: H04N 1/147
Title of the Invention: METHOD AND APPRATUS FOR INTRA-FRAME PREDICTIVE CODING AND DECODING
Number of Claim(s): 24
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Payment of Fees:
 Prepayment Book No.: 011305
 Amount to be paid: ¥ 21,000
Attached document:
 Item: Specification 1 copy
 Item: Drawing 1 copy
 Item: Abstract 1 copy
 Registration No. 9308195
 of General Power
Request for proof transmission: Yes

Document Name: SPECIFICATION

Title of the Invention:

METHOD AND APPARATUS FOR INTRA-FRAME PREDICTIVE
CODING AND DECODING

5 Claims:

1. An image predictive coding apparatus
characterized in that,

in a process of receiving an image to be coded,
dividing the image to be coded into a plurality of adjacent
10 small regions and coding a target small region among the
plurality of adjacent small regions,

said apparatus performs the following steps of:
using reproduced pixel values adjacent to the target small
region as pixel values of an intra-frame prediction small
15 region of the target small region; using the intra-frame
prediction small region as an optimum prediction small
region; generating a difference small region from the
target small region and the optimum prediction small
region; coding the difference small region; after these
20 steps, decoding the coded difference small region, adding
the decoded difference small region to the optimum
prediction small region, and generating and storing a
reproduced small region.

2. The image predictive coding apparatus as
25 claimed in Claim 1,

wherein vertically adjacent reproduced pixel values are used as the pixel values of the intra-frame prediction small region.

3. The image predictive coding apparatus as
5 claimed in Claim 1,

wherein horizontally adjacent reproduced pixel values are used as pixel values of the intra-frame prediction small region.

4. The image predictive coding apparatus as
10 claimed in Claim 1,

wherein vertically adjacent reproduced pixel values are used as pixel values of a first intermediate small region, horizontally adjacent reproduced pixel values are used as pixel values of a second intermediate small
15 region, and the pixel values of the first intermediate small region and the pixel values of the second intermediate small region are weighted and averaged so as to be used as the pixel values of the intra-frame prediction small region.

20 5. The image predictive coding apparatus as claimed in Claim 1,

wherein vertically adjacent reproduced pixel values are used as pixel values of a first intermediate small region, horizontally adjacent reproduced pixel values
25 are used as pixel values of a second intermediate small

region, the pixel values of the first intermediate small region and the pixel values of the second intermediate small region are weighted and averaged so as to be used as pixel values of a third intermediate small region, and
5 pixel values of one of the first, second and third intermediate small regions are used as the pixel values of the intra-frame prediction small region.

6. The image predictive coding apparatus as claimed in Claim 1,

10 wherein one of the first, second and third intermediate small regions, whichever it has the smallest error with respect to the target small region, is used as the intra-frame prediction small region, an identifier for identifying the first, second and third intermediate small
15 regions is added to the intra-frame prediction small region, and the coding process is performed.

7. The image predictive coding apparatus as claimed in any one of Claims 1 to 5, further performing a step of generating a time prediction small region from at
20 least one reference image which has been coded and reproduced previously in time in addition to the intra-frame prediction small region,

wherein pixel value of one of the intra-frame prediction small region and the time prediction small
25 region are used as the pixel value of the optimum

prediction small region.

8. The image predictive coding apparatus as claimed in Claim 7,

5 wherein an identifier for identifying the intra-frame prediction small region and the time prediction small region is added and the coding process is performed.

9. An image predictive coding apparatus characterized in that,

10 in a process of receiving an image to be coded and a significant signal showing whether or not a pixel value of the image to be coded is significant, dividing the image to be coded into a plurality of adjacent small regions and coding a target small region among the plurality of adjacent small regions,

15 said apparatus performs the following steps of: using only significant pixel values among the reproduced pixel values adjacent to the target small region as pixel values of an intra-frame prediction small region of the target small region; using the intra-frame prediction small
20 region as an optimum prediction small region; generating a difference small region from the target small region and the optimum prediction small region; coding the difference small region; after these steps, decoding the coded difference small region, adding the decoded difference
25 small region to the optimum prediction small region, and

generating and storing a reproduced small region.

10. The image predictive coding apparatus as claimed in Claim 9,

5 wherein only significant pixel values among vertically adjacent reproduced pixel values are used as the pixel values of the intra-frame prediction small region.

11. The image predictive coding apparatus as claimed in Claim 9,

10 wherein only significant pixel values among horizontally adjacent reproduced pixel values are used as the pixel values of the intra-frame prediction small region.

12. The image predictive coding apparatus as claimed in Claim 9,

15 wherein only significant pixel values among vertically adjacent reproduced pixel values are used as pixel values of a first intermediate small region, only significant pixel values among horizontally adjacent reproduced pixel values are used as pixel values of a
20 second intermediate small region, and the pixel values of the first intermediate small region and the pixel values of the second intermediate small region are weighted and averaged so as to be used as the pixel values of the intra-frame prediction small region.

25 13. The image predictive coding apparatus as

claimed in Claim 9,

wherein only significant pixel values among vertically adjacent reproduced pixel values are used as pixel values of a first intermediate small region, only
5 significant pixel values among horizontally adjacent reproduced pixel values are used as pixel values of a second intermediate small region, the pixel values of the first intermediate small region and the pixel values of the second intermediate small region are weighted and averaged
10 so as to be used as pixel values of a third intermediate small region, and the pixel values of one of the first, second and third intermediate small regions are used as the intra-frame prediction small region.

14. The image predictive coding apparatus as
15 claimed in Claim 9,

wherein an average value of only significant pixel values among the reproduced pixel values adjacent to the target small region is used as a pixel value of the intra-frame prediction small region.

20 15. The image predictive coding apparatus as claimed in any one of Claims 9 to 14,

further performing a step of generating a time prediction small region from at least one reference image which has been coded and reproduced previously in time in
25 addition to the intra-frame prediction small region,

wherein pixel value of one of the intra-frame prediction small region and the time prediction small region are used as the pixel value of the optimum prediction small region.

5 16. An image predictive decoding apparatus comprising:

 an input terminal, a data analyzer, a decoder, an adder, a prediction signal generator and a line memory,

 wherein said image predictive coding apparatus
10 performs the following steps of:

 receiving an input of a coded image data series through the input terminal;

 analyzing the coded image data series and outputting an image difference signal by the data analyzer;

15 inputting the difference image signal to the decoder and restoring it to a reproduction difference small region;

 inputting pixel values to the prediction signal generator from the line memory, using reproduced pixel
20 values adjacent to the reproduction difference small region as pixel values of an intra-frame prediction small region, and outputting the intra-frame prediction small region as an optimum prediction small region; and

 adding the reproduction difference small region
25 to the optimum prediction small region by the adder,

outputting an image and storing only pixel values for generating the intra-frame prediction small region into the line memory.

17. An image predictive decoding apparatus as
5 claimed in Claim 16,

wherein vertically adjacent reproduced pixel values are used as pixel values of a first intermediate small region, horizontally adjacent reproduced pixel values are used as pixel values of a second intermediate small
10 region, the pixel values of the first intermediate small region and the pixel values of the second intermediate small region are weighted and averaged so as to be used as pixel values of a third intermediate small region, and pixel values of one of the first, second and third
15 intermediate small regions are used as the pixel values of the intra-frame prediction small region.

18. An image predictive decoding apparatus comprising:

an input terminal, a data analyzer, a decoder, an
20 adder, a prediction signal generator, a line memory, a motion compensator, a frame memory and a controller,

wherein said image predictive coding apparatus performs the following steps of:

receiving an input of a coded image data series
25 through the input terminal;

analyzing the coded image data series and outputting an image difference signal, a motion vector signal and a control signal by the data analyzer;

inputting the difference image signal to the
5 decoder and restoring it to a reproduction difference small region;

inputting the control signal to the controller and outputting a switching signal for controlling the motion compensator and the prediction signal generator;

10 when the motion compensator is operated by the switching signal, inputting the motion vector signal to the motion compensator, acquiring a time prediction small region from the frame memory and outputting an optimum prediction small region;

15 when the prediction signal generator is operated by the switching signal, inputting pixel values from the line memory to the prediction signal generator, using reproduced pixel values adjacent to the reproduction difference small region as pixel values of an intra-frame
20 prediction small region and outputting the intra-frame prediction small region as an optimum prediction small region; and

adding the reproduction difference small region to the optimum prediction small region to thereby output
25 reproduction image and simultaneously storing the

reproduction image into the frame memory, and storing only pixel values for generating the intra-frame prediction small region into the line memory.

19. The image predictive decoding apparatus as
5 claimed in Claim 18,

wherein vertically adjacent reproduced pixel values are used as pixel values of a first intermediate small region, horizontally adjacent reproduced pixel values are used as pixel values of a second intermediate small
10 region, the pixel values of the first intermediate small region and the pixel values of the second intermediate small region are weighted and averaged so as to be used as pixel values of a third intermediate small region, and pixel values of one of the first, second and third
15 intermediate small regions are used as the pixel values of the intra-frame prediction small region according to the switching signal.

20. An image predictive decoding apparatus comprising:

20 an input terminal, a data analyzer, a first decoder, a second decoder, an adder, a prediction signal generator and a line memory,

wherein said image predictive coding apparatus performs the following steps of:

25 receiving an input of a coded image data series

through the input terminal;

analyzing the coded image data series and
outputting a compressed shape signal and an image
difference signal by the data analyzer;

5 inputting the compressed shape signal to the
first decoder and restoring it to a reproduction shape
signal;

 inputting the difference image signal to the
second decoder and restoring it to a reproduction
10 difference small region;

 inputting pixel values to the prediction signal
generator from the line memory, using only significant
pixel values shown by the reproduction shape signal among
the reproduced pixel values adjacent to the reproduction
15 difference small region as pixel values of an intra-frame
prediction small region, and outputting the intra-frame
prediction small region as an optimum prediction small
region; and

 adding the reproduction difference small region
20 to the optimum prediction small region by the adder,
outputting an image and storing only pixel values for
generating the intra-frame prediction small region into the
line memory.

21. The image predictive decoding apparatus as
25 claimed in Claim 20,

wherein only significant pixel values shown by a reproduction shape signal among vertically adjacent reproduced pixel values are used as pixel values of a first intermediate small region, only significant pixel values shown by the reproduction shape signal among horizontally adjacent reproduced pixel values are used as pixel values of a second intermediate small region, the pixel values of the first intermediate small region and the pixel values of the second intermediate small region are weighted and averaged so as to be used as pixel values of a third intermediate small region, and the pixel values of one of the first, second and third intermediate small regions are used as pixel values of the intra-frame prediction small region.

22. An image predictive decoding apparatus comprising:

an input terminal, a data analyzer, a first decoder, a second decoder, an adder, a prediction signal generator, a line memory, a motion compensator, a frame memory and a controller,

wherein said image predictive coding apparatus performs the following steps of:

receiving an input of a coded image data series through the input terminal;

analyzing the image data series and outputting a

compressed shape signal, an image difference signal, a motion vector signal and a control signal by the data analyzer;

inputting the compressed shape signal to the
5 first decoder and restoring it to a reproduction shape signal;

inputting the difference image signal to the second decoder and restoring it to a reproduction difference small region;

10 inputting the control signal to the controller and outputting a switching signal for controlling the motion compensator and the prediction signal generator;

when the motion compensator is operated by the switching signal, inputting the motion vector signal to the
15 motion compensator, acquiring a time prediction small region from the frame memory according to the motion vector signal and outputting an optimum prediction small region;

when the prediction signal generator is operated by the switching signal, inputting pixel values from the
20 line memory to the prediction signal generator, using only significant pixel values shown by the reproduction shape signal among reproduced pixel values adjacent to the reproduction difference small region as pixel values of an intra-frame prediction small region and outputting the
25 intra-frame prediction small region as an optimum

prediction small region; and

adding the reproduction difference small region to the optimum prediction small region to thereby output a reproduction image and simultaneously storing the reproduction image into the frame memory, and storing only
5 pixel values for generating the intra-frame prediction small region into the line memory.

23. The image predictive decoding apparatus as claimed in Claim 21,

10 wherein only significant pixel values shown by a reproduction shape signal among vertically adjacent reproduced pixel values are used as pixel values of a first intermediate small region, only significant pixel values shown by the reproduction shape signal among horizontally
15 adjacent reproduced pixel values are used as pixel values of a second intermediate small region, the pixel values of the first intermediate small region and the pixel values of the second intermediate small region are weighted and averaged so as to be used as pixel values of a third
20 intermediate small region, and the pixel values of one of the first, second and third intermediate small regions are used as pixel values of the intra-frame prediction small region according to the switching signal.

24. The image predictive decoding apparatus as
25 claimed in Claim 20 or 22,

wherein an apparatus as claimed in Claim 20 or
22,

wherein an average value is determined by using
only significant pixel values shown by the reproduction
5 shape signal so as to be used as pixel values of the intra-
frame prediction small region.

Detailed Description of the Invention:

[0001]

Field of the Invention:

10 The present invention relates to compression
coding and decoding method and apparatus for storing or
transmitting digital image data, and more particularly, the
invention relates to method and apparatus for prediction
within an image.

15 [0002]

Prior Art:

For the purpose of efficiently storing or
transmitting a digital image, the image is required to be
coded in a compression coding manner. As a method for
20 coding a digital image in a compression coding manner,
there is a waveform coding method of sub-band coding,
wavelet coding, fractal coding or the like other than
discrete cosine transform (DCT) represented by the JPEG and
the MPEG. For the purpose of removing a redundant signal
25 between images, an inter-image prediction with a motion

compensation is executed, thereby subjecting a differential signal to waveform coding.

[0003]

According to the MPEG system, an input image is
5 processed while being divided into a plurality of 16×16
macro blocks. One macro block is further divided into 8×8
blocks and quantized after undergoing 8×8 DCT
transform. This is called an intra-frame coding.

[0004]

10 On the other hand, according to a motion
detection method inclusive of block matching, a prediction
macro block having the minimum error with respect to the
target macro block is detected from other frames adjacent
in time, the detected prediction macro block is subtracted
15 from the target macro block thereby forming a differential
macro block, and this macro block is quantized after
undergoing 8×8 DCT transform. This is called an inter-
frame coding, and the prediction macro block is called a
prediction signal of the time region. According to the
20 MPEG described above, no image is predicted from an
identical frame.

[0005]

A normal image has spatially similar regions, and
an image can be approximated to a spatial region by
25 utilizing this characteristic. In a manner similar to that

of the prediction signal of the time region, a prediction signal can also be obtained from an identical frame. This is called a prediction signal of the spatial region.

[0006]

5 Problems to be Solved by the Invention:

Since spatially adjacent two pixel values are close to each other, the prediction signal of the spatial region is generally located close to the target signal. On the other hand, on the receiving side or the reproducing side, a signal which has been coded and reproduced in the
10 past is required to be used for the prediction signal since the original image is absent. From these two factors, the prediction signal of the spatial region is required to be generated at high speed. This is because the signal is
15 used for the generation of a prediction signal immediately after the pixel value is decoded and reproduced.

[0007]

Therefore, the prediction signal of the spatial region is required to be generated simply with high
20 accuracy. Furthermore, a speedily operable construction is required in coding and decoding apparatus.

[0008]

The present invention has an object of generating a spatial prediction signal with simplicity, high speed and
25 high precision, and provides coding and decoding apparatus

having a speedily operable construction.

[0009]

Means for Solving the Problems:

To achieve this object, according to the present
5 invention, there is provided an image predictive coding
apparatus characterized in that,

in a process of dividing an image to be coded
into a plurality of adjacent small regions and coding a
target small region among the plurality of adjacent small
10 regions,

said apparatus performs the following steps of:
using reproduced pixel values adjacent to the target small
region as pixel values of an intra-frame prediction small
region of the target small region; using the intra-frame
15 prediction small region as an optimum prediction small
region; generating a difference small region from the
target small region and the optimum prediction small
region; coding the difference small region; after these
steps, decoding the coded difference small region, adding
20 the decoded difference small region to the optimum
prediction small region, and generating and storing a
reproduced small region.

[0010]

Further, said image predictive coding apparatus
25 further performs a step of generating a time prediction

small region from at least one reference image which has been coded and reproduced previously in time in addition to the intra-frame prediction small region,

wherein pixel value of one of the intra-frame
5 prediction small region and the time prediction small region are used as the pixel value of the optimum prediction small region.

[0011]

Also, according to the present invention, there
10 is provided an image predictive decoding apparatus comprising:

an input terminal, a data analyzer, a decoder, an adder, a prediction signal generator and a line memory,

wherein said image predictive coding apparatus
15 performs the following steps of: receiving an input of a coded image data series through the input terminal; analyzing the coded image data series and outputting an image difference signal by the data analyzer; inputting the difference image signal to the decoder and restoring it to
20 a reproduction difference small region; inputting pixel values to the prediction signal generator from the line memory, using reproduced pixel values adjacent to the reproduction difference small region as pixel values of an intra-frame prediction small region, and outputting the
25 intra-frame prediction small region as an optimum

prediction small region; and adding the reproduction difference small region to the optimum prediction small region by the adder, outputting an image and storing only pixel values for generating the intra-frame prediction small region into the line memory.

[0012]

Embodiments of the Invention:

Embodiments of the present invention will be described below with reference to Figs. 1 to 10.

10 [0013]

(Embodiment 1)

Fig. 1 shows a block diagram of an image predictive coding apparatus according to the Embodiment 1 of the present invention. In Fig. 1 are shown an input terminal 101, a first adder 102, an encoder 103, an output terminal 106, a decoder 107, a second adder 110, a line memory 111 and a prediction signal generator 112.

[0014]

20 With regard to the image predictive coding apparatus constructed as shown above, its operation is described below. A target image to be subjected to a coding process is inputted to the input terminal 101. The inputted image is divided into a plurality of adjacent small regions. Fig. 2 shows the input image in a case where it is divided into 8×8 small regions. Fig. 3 shows

25

the inputted image in a case where it is divided into triangular small regions. The plurality of small regions are successively coded, where a target small region is inputted to the first adder 102 via a line 113. The
5 prediction signal generator 112 generates an intra-frame prediction small region and inputs the resulting intra-frame prediction small region as an optimum prediction small region to the first adder 102 via a line 121.

[0015]

10 The first adder 102 subtracts the corresponding pixel value of the optimum prediction small region from the pixel value of the target small region, thereby generating a difference small region and inputting the difference small region to the encoder 103 for the execution of a
15 compression coding process. In the present embodiment, the difference small region is transformed into an image signal of a frequency region by the DCT transformer (104). Then, DCT transform coefficients are quantized by a quantizing unit Q (105). The quantized small region is outputted to
20 the output terminal 106, further transformed into a code of a variable length or a fixed length and thereafter stored or transmitted (not shown).

[0016]

At the same time, the quantized small region is
25 outputted to the decoder 107, where it is restored to an

expanded difference small region. In the present embodiment, the small region is inverse quantized by the inverse quantizing unit 108, and thereafter transformed into a signal of a spatial region by an inverse discrete cosine transformer IDCT (109). The thus-obtained expanded difference small region is outputted to the second adder 110, and the second adder 110 adds an optimum prediction image signal outputted via the lines 121 and 122 to thereby generate a reproduction small region and stores a reproduction pixel value for generating an intra-frame prediction image signal from the reproduction small region reproduction small region into the line memory 111. The prediction signal generator 112 generates the intra-frame prediction small region as follows.

[0017]

That is, the prediction signal generator 112 generates a pixel value of the reproduced small region adjacent to the target small region as a pixel value of the intra-frame prediction small region. In Fig. 2, assuming that a block 200 is the target small region, then the pixel values of the adjacent reproduced small region are $a_0, a_1, a_2, \dots, a_6, a_7, b_0, b_1, b_2, \dots, b_6, b_7$. In Fig. 3, assuming that a triangle 301 is the target small region, then the pixel values of the adjacent reproduced small region are $g_0, g_1, \dots, g_4, f_0, f_1, f_2, \dots, f_7, f_8$.

[0018]

Assuming that a triangle 300 is the target small region, the pixel values of the adjacent small region are e0, h0, h1, ..., h4. These pixel values are stored into
5 the line memory 111. The prediction signal generator 112 makes access to the line memory 111 to read out the adjacent pixel values as the pixel values of the intra-frame prediction small region.

[0019]

10 Fig. 4A and Fig. 4B show block diagrams of an embodiment in which an intra-frame prediction small region of a block 200 of Fig. 2 is generated. In Fig. 4A, the pixel values a0, a1, a2, ..., a6, a7 which are vertically adjacent to one another are inputted, and a generator 401
15 generates an intra-frame prediction small region 403 by repetitively outputting an identical pixel in the horizontal direction. The intra-frame prediction small region 403 is used in a case where no horizontally adjacent pixel exists. In Fig. 4B, the pixel values b0, b1, b2,
20 ..., b6, b7 which are horizontally adjacent to one another are inputted, and a generator 402 generates an intra-frame prediction small region 404 by repetitively outputting a pixel in the vertical direction.

[0020]

25 The intra-frame prediction small region 404 is

used in a case where no horizontally adjacent pixel exists.
In a case where pixels which are adjacent in both the
horizontal direction and the vertical direction exist, an
intra-frame prediction small region is generated as in an
embodiment shown in Fig. 5.

[0021]

That is, an adder 500 averages the intra-frame
prediction small region 403 and the intra-frame prediction
small region 404. Thus, the adjacent reproduced pixels are
repetitively outputted and the averaging computation is
merely executed, and therefore, the intra-frame prediction
small region can be generated at high speed. It is
acceptable to generate the intra-frame prediction small
region by linearly interpolating adjacent pixel values.

[0022]

Fig. 6 shows a block diagram of a third
embodiment of the prediction signal generator 112. The
pixel values a0, a1, a2, ..., a6, a7 which are vertically
adjacent to one another are inputted, and the generator 401
generates a first intra-frame prediction small region by
repetitively outputting each pixel in the horizontal
direction. The pixel values b0, b1, b2, ..., b6, b7 which
are horizontally adjacent to one another are inputted, and
the generator 402 generates a second intra-frame prediction
small region by repetitively outputting each pixel in the

vertical direction. The first intra-frame prediction small region and the second intra-frame prediction small region are inputted to the adder 500, and a third intra-frame prediction small region is generated by averaging these two
5 small regions.

[0023]

On the other hand, the target small region is inputted via a line 616. The first intra-frame prediction small region and the target small region are inputted to an
10 error calculator 601, and the error calculator 601 calculates a first absolute error. The second intra-frame prediction small region and the target small region are inputted to an error calculator 602, and the error calculator 602 calculates a second absolute error. The
15 third intra-frame prediction small region and the image data of the target small region are inputted to an error calculator 603, and the error calculator 603 calculates a third absolute error. The first, second and third absolute errors are inputted to a comparator 604. The comparator
20 604 determines the one having the smallest absolute error and controls a switch 605 so as to output the intra-frame prediction small region corresponding to it to the line 121.

[0024]

25 The comparator 604 simultaneously outputs an

identifier for identifying the first, second and third intra-frame prediction small regions via a line 615. With this identifier, the intra-frame prediction small region is uniquely determined on the receiving side. Thus by using the intra-frame prediction small region having the smallest error, a differential signal can be suppressed, thereby allowing the reduction in the number of bits to be generated.

[0025]

10 (Embodiment 2)

Fig. 7 shows a block diagram of an image predictive coding apparatus according to the Embodiment 2 of the present invention. In this image predictive coding apparatus, a motion detector 700, a motion compensator 701, an optimum mode selector 703 and a frame memory 702 are added to the construction of Fig. 1.

[0026]

With regard to the image predictive coding apparatus as described above, its operation will be described below. In a manner similar to that of the Embodiment 1, the target small region of an input image is inputted. The adder 102 subtracts the target small region from an optimum prediction small region inputted via a line 121. The encoder 103 outputs the subtraction result to an output terminal 106 while encoding the data in a

compression coding manner. At the same time, the decoder 107 expands the compressed small region, and thereafter the optimum prediction small region is added.

[0027]

5 Then, in a manner similar to that of the Embodiment 1, only the pixel value to be used for generating an intra-frame prediction small region is stored into a line memory 111, while all the pixel values of the reproduced image are stored into the frame memory 702.

10 [0028]

 When the next image is inputted, the motion detector 700 receives the inputs of the target small region and the reproduction image stored in the frame memory 702, and the motion detector 700 detects the motion of the image
15 by block matching or similar method and outputs a motion vector to a line 705. The outputted motion vector is subjected to variable length coding, and transmitted (not shown) and simultaneously transmitted to the motion compensator 701. The motion compensator 701 generates a
20 time prediction small region from the reproduction image of the frame memory 702 on the basis of the motion vector and input the same to the optimum mode selector 703. The motion detecting process and the motion compensating process include forward prediction, backward prediction and
25 bidirectional prediction, and these methods are disclosed

in, for example, U.S.P. No. 5,193,004.

[0029]

On the other hand, in a manner similar to that of the Embodiment 1, the prediction signal generator 112 generates the intra-frame prediction small region, and inputs the intra-frame prediction small region to the optimum mode selector 703 and simultaneously inputs the target small region to the optimum mode selector 703. The optimum mode selector 703 selects the image data having the smallest error (e.g., the sum of the absolute values of differences obtained every pixel) with respect to the target small region from the intra-frame prediction small region and a time prediction small region and outputs the selected image data as an optimum prediction small region to the adder 102. An identifier representing the prediction small region which has been selected is outputted to be transmitted via a line 709.

[0030]

As described above, there is no need for transmitting any inter-frame motion vector by introducing the intra-frame prediction to the image data coded with inter-frame motion compensation, and therefore, the number of bits can be further reduced.

[0031]

The Embodiments 1 and 2 are in the case where

significant pixels exist throughout the entire screen. There is a case where a significant pixel and an insignificant pixel exist in a screen. For example, in the case of an image picked up by chromakey, pixels expressing
5 the subject are significant, and pixels expressing a region in blue or the like which serves as a background are insignificant pixels. By transmitting the texture and shape of the significant object through coding, reproduction and display of each object can be achieved.
10 When generating the intra-frame prediction small region by the prediction signal generator 112 for such an input image, insignificant pixel values cannot be used.

[0032]

Fig. 8 shows a schematic view of input images
15 having significant pixels and insignificant pixels. A shape signal is used for expressing whether or not the pixel is significant. The shape signal is compression-coded by a specified method and transmitted. As a method for coding a shape, a chain coding method and the like are
20 available. A compressed shape signal is reproduced by being expanded again, and the reproduced shape signal is used for generating an intra-frame prediction image signal as follows.

[0033]

25 In Fig. 8A, a shape curve 800 is the boundary

line and the direction indicated by arrow is the inside of an object, which is comprised of significant pixels. Among the reproduced pixels adjacent to a target small region 802, b4, b5, b6 and b7 are the significant pixels, and only
5 these pixel values are repetitively used as the pixel values of the intra-frame prediction small region of the target small region 802. In Fig. 8B, a shape curve 804 is the boundary line, and the direction indicated by arrow is the inside of an object, which is comprised of significant
10 pixels. Among the reproduced pixels adjacent to a target small region 805, a4, a5, a6 and a7 are the significant pixels, and only these pixel values are repetitively used as the pixel values of the intra-frame prediction small region of the target small region 805.

15 [0034]

Further, in Fig. 8C, a curve 808 is the boundary line, and the direction indicated by arrow is the inside of an object, which is comprised of significant pixels. Among the reproduced pixels adjacent to a target small region
20 810, a5, a6, a7, b4, b5, b6 and b7 are the significant pixels, and only these pixel values are repetitively outputted. In a place where two pixel values overlap each other, a value obtained by averaging those pixel values is used as the pixel value of the intra-frame prediction small
25 region of the target small region 810.

[0035]

For example, the value of a pixel z_{77} of the target small region 810 is the average value of a_7 and b_7 . In a place where no pixel exists, the average value of horizontally and vertically adjacent two pixel values is taken. For example, the value of a pixel z_{14} is the average value of a_5 and b_3 . Thus, the intra-frame prediction small region of an image having an arbitrary shape is generated. Although the aforementioned embodiment has been described on the basis of a small region divided in a square shape, the screen may be divided into triangular small regions as in Fig. 3.

[0036]

As another embodiment, it is acceptable to determine the average value by using only the significant pixel values and use the average value as the pixel value of the intra-frame prediction small region. In Fig. 8A, the average value of the pixels b_4 , b_5 , b_6 and b_7 is calculated, and the calculated average value is used as the pixel value of the intra-frame prediction small region. In Fig. 8B, the average value of the pixels a_4 , a_5 , a_6 and a_7 is calculated, and the calculated average value is used as the pixel value of the intra-frame prediction small region. In Fig. 8C, the average value of the pixels a_5 , a_6 , a_7 , b_4 , b_5 , b_6 and b_7 is calculated, and it is used as the pixel

value of the intra-frame prediction small region.

[0037]

(Embodiment 3)

Fig. 9 is a block diagram showing an image
5 predictive decoding apparatus according to the Embodiment
3 of the present invention. In Fig. 9 are shown an input
terminal 901, a data analyzer 902, a decoder 903, an adder
906, an output terminal 907, a controller 908, a motion
compensator 909, a prediction signal generator 910, a line
10 memory 911 and a frame memory 912.

[0038]

With regard to the image predictive decoding
apparatus constructed as shown above, its operation is
described below. Compression-coded image data is inputted
15 to the data analyzer 902. The data analyzer 902 analyzes
the inputted image data, outputs data of a compressed
difference small region to the decoder 903 via a line 915,
outputs a control signal to the controller 908 via a line
926 and further outputs the motion vector (only when it
20 exists) to the motion compensator 909. The decoder 903
expands the difference small region to restore the data
into an expanded difference small region.

[0039]

In the present embodiment, the compressed image
25 data of the difference small region is inverse quantized by

the inverse quantizing unit Q (904), and the signal of a frequency region is transformed into a signal of a spatial region by the inverse IDCT (905). The expanded difference small region is inputted to the adder 906, and the adder 5 906 adds an optimum prediction small region transmitted via a line 924, thereby generating a reproduction small region. The adder 906 outputs the reproduced image to the output terminal 907 and simultaneously stores the image into the frame memory 912. The pixel values for use in generating 10 an intra-frame prediction small region are stored into the line memory 911.

[0040]

The optimum prediction small region is determined by the controller 908 on the basis of a control signal. In 15 a case where the intra-frame prediction small region is selected, the switch 913 is connected to the line 922, so that the prediction signal generator 910 makes access to the line memory 911 to output the adjacent reproduction pixel value as the pixel value in the intra-frame 20 prediction small region. The details have already been described with reference to Fig. 4A, Fig. 4B and Fig. 5. In a case where a time prediction small region is selected, the switch 913 is connected to the line 923, so that the motion compensator 909 generates the time prediction small 25 region from the frame memory 912, and outputs it, on the

basis of a motion vector transmitted via a line 925.

[0041]

(Embodiment 4)

Fig. 10 is a block diagram showing an image
5 predictive decoding apparatus according to the Embodiment
4 of the present invention. A shape decoder 1000 is added
to the basic construction of Fig. 9. The basic operation
of the image predictive decoding apparatus is the same as
that of Fig. 9, and therefore, only the different operation
10 will be described below.

[0042]

In the present embodiment, the compression-coded
image data includes compression-coded shape data. The data
analyzer 902 extracts the shape data and outputs the same
15 to the shape decoder 1000, where the shape decoder 1000
reproduces a shape signal in an expanding manner. The
reproduced shape signal, upon being outputted, is inputted
to the prediction signal generator 910. The prediction
signal generator 910 generates an intra-frame prediction
20 small region as described with reference to Fig. 8 based on
this reproduced shape signal. Thus, the intra-frame
prediction small region of the image having an arbitrary
shape is generated, and the image can be decoded and
reproduced.

25 [0043]

The Embodiments 3 and 4 are characterized by the line memory 911. In the absence of the line memory 911, access must be made from the frame memory 912 to a pixel for generating the intra-frame prediction small region.

5 For the purpose of generating a prediction signal by pixels of the adjacent small region, it is required to execute write and read out the same at high speed on the frame memory. By providing a special line memory or buffer, the intra-frame prediction small region can be generated at

10 high speed without using any high-speed frame memory.

[0044]

Effects of the Invention:

As described above, according to the present invention, by merely using the reproduced pixel values adjacent to the target small region as the pixel values of

15 the intra-frame prediction signal, a high-accuracy prediction signal can be simply generated with a smaller amount of computation, and this can produce an effect that the number of bits of the intra-frame coding can be

20 reduced. The line memory is provided for storing therein the reproduced pixel values for use in generating the intra-frame prediction signal, and therefore, access can be made at high speed to the pixel values, thereby allowing the intra-frame prediction signal to be generated at high

25 speed.

Brief Description of the Drawings:

Fig. 1 is a block diagram showing an image predictive coding apparatus according to the Embodiment 1 of the present invention;

5 Fig. 2 is a schematic view in a case where an input image for use in the image predictive coding apparatus according to an embodiment of the present invention is divided into 8×8 blocks;

10 Fig. 3 is a schematic view in a case where an input image for use in the image predictive coding apparatus according to an embodiment of the present invention is divided into triangular regions;

15 Fig. 4 is a block diagram showing a first embodiment of a prediction signal generator for use in the image predictive coding apparatus according to an embodiment of the present invention;

20 Fig. 5 is a block diagram showing a second embodiment of a prediction signal generator for use in the image predictive coding apparatus according to an embodiment of the present invention;

Fig. 6 is a block diagram showing a third embodiment of a prediction signal generator for use in the image predictive coding apparatus according to an embodiment of the present invention;

25 Fig. 7 is a block diagram showing an image

predictive coding apparatus according to the Embodiment 2 of the present invention;

Fig. 8 is a schematic view showing an input image which is inputted to the image predictive coding apparatuses according to an embodiment of the present invention and includes significant and insignificant pixels;

Fig. 9 is a block diagram showing an image predictive decoding apparatus according to the Embodiment 3 of the present invention; and

Fig. 10 is a block diagram showing an image predictive decoding apparatus according to the Embodiment 4 of the present invention.

Reference numerals:

- 101 input terminal
- 102 first adder
- 103 encoder
- 104 DCT transformer
- 105 quantizing unit
- 106 output terminal
- 107 local decoder
- 108 inverse quantizing unit
- 109 inverse DCT transformer
- 110 second adder
- 111 line memory

- 38 -

112 prediction signal generator

Fig. 1

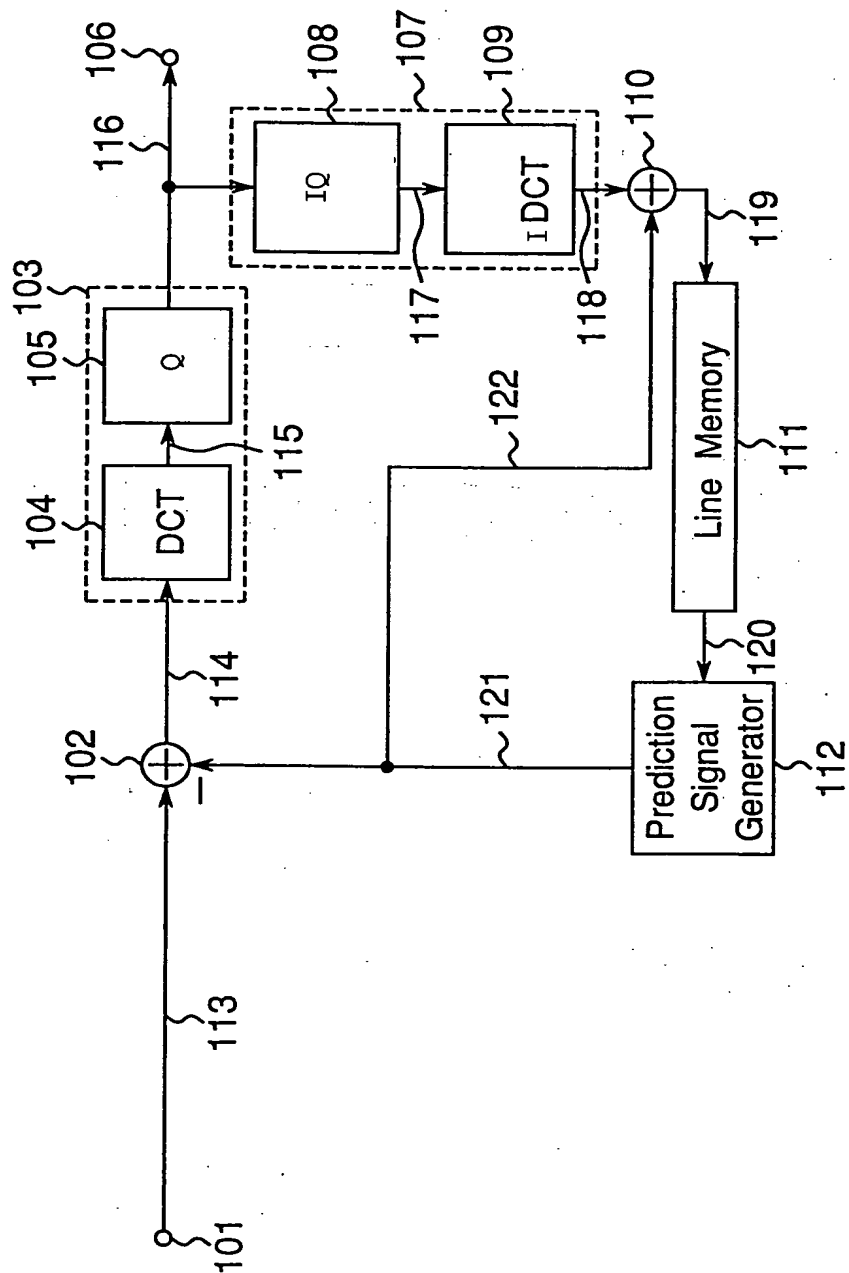


Fig.2

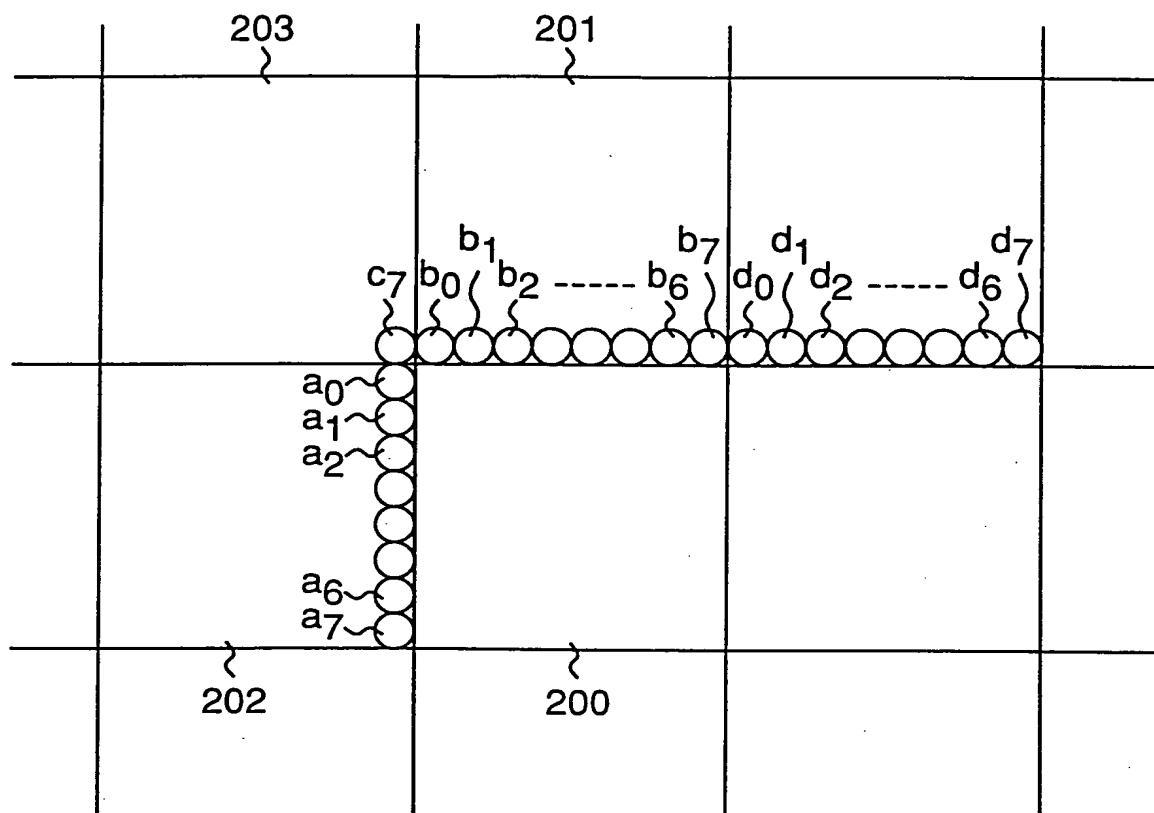


Fig.3

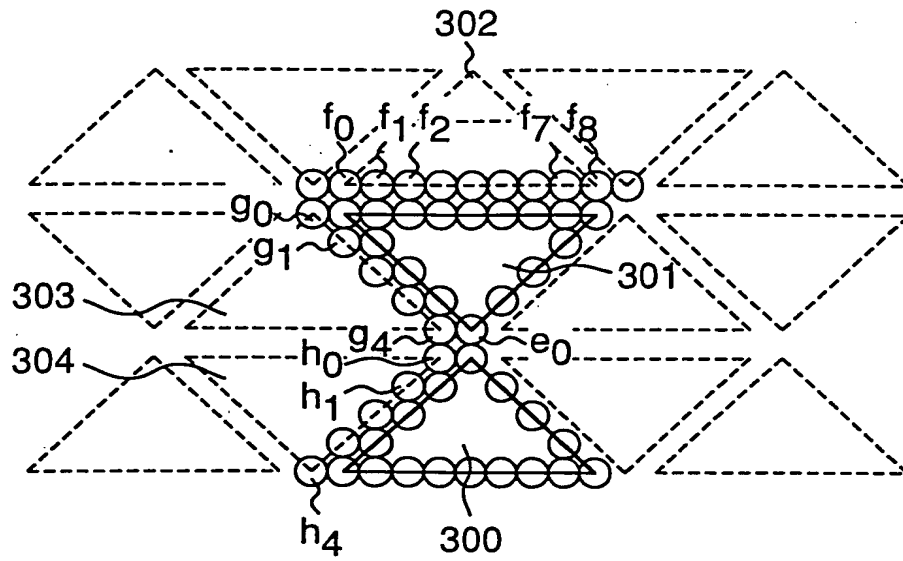


Fig. 4

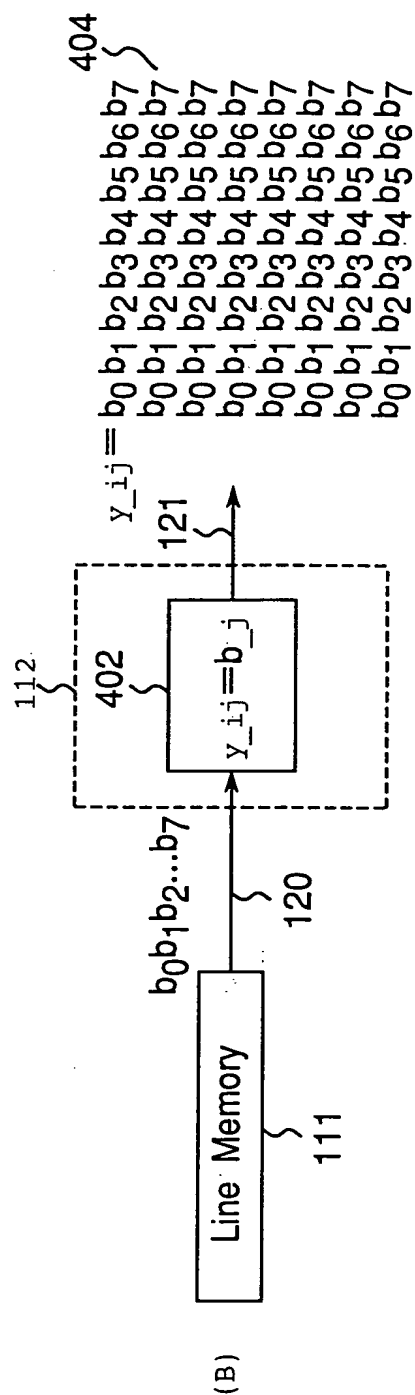
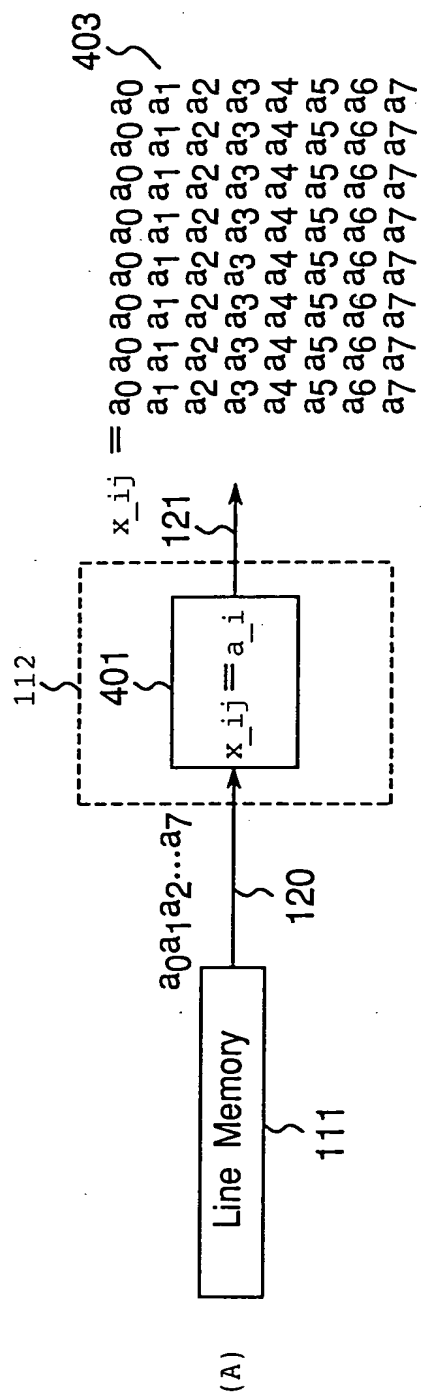


Fig. 5

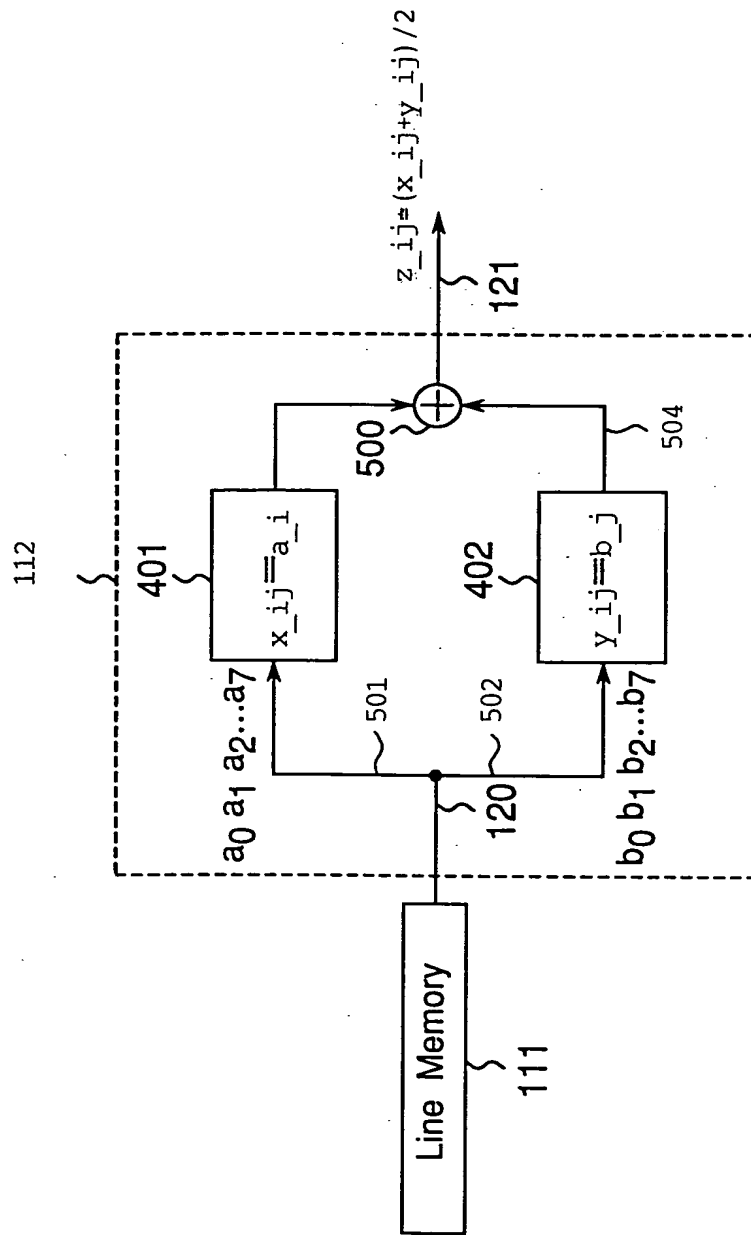


Fig. 6

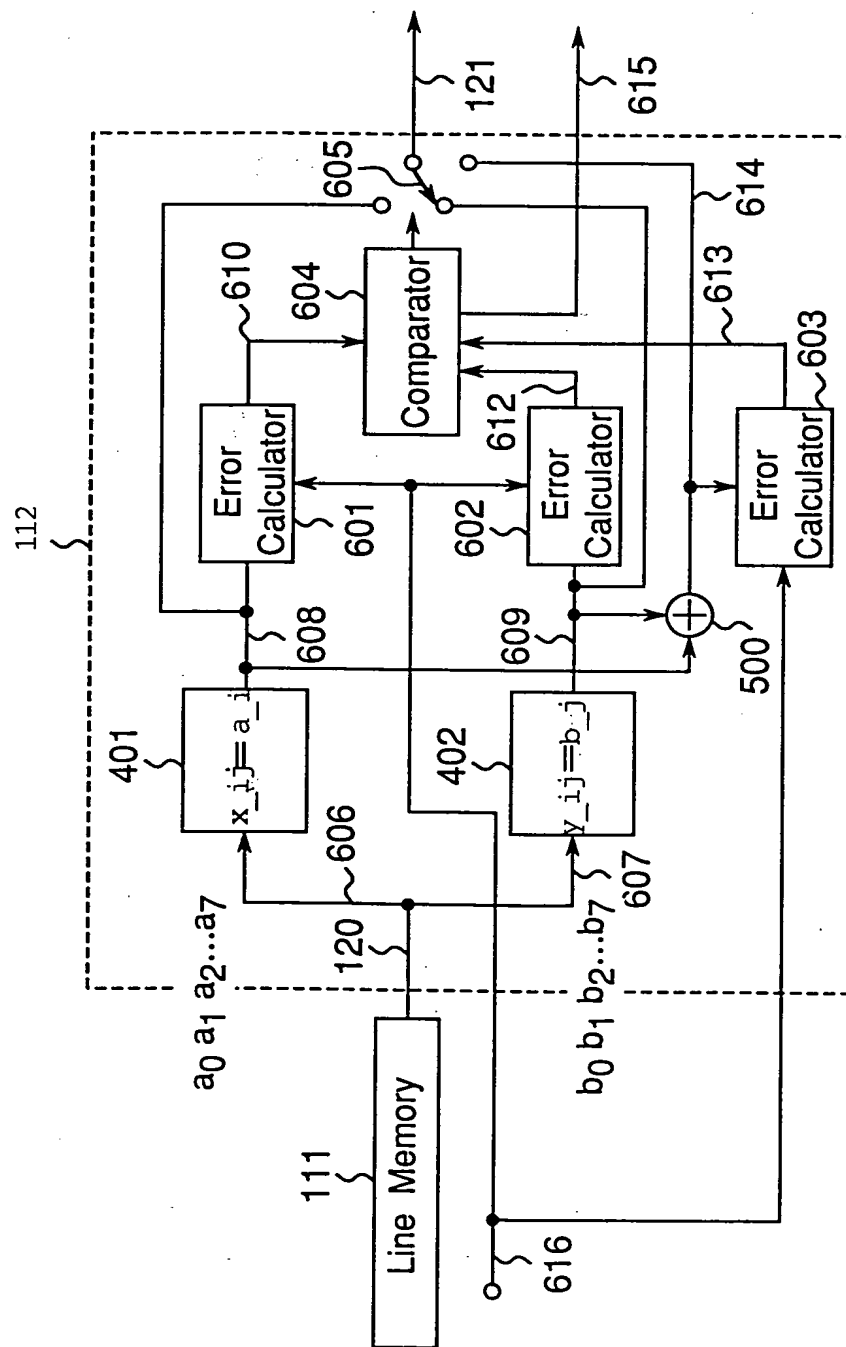


Fig. 7

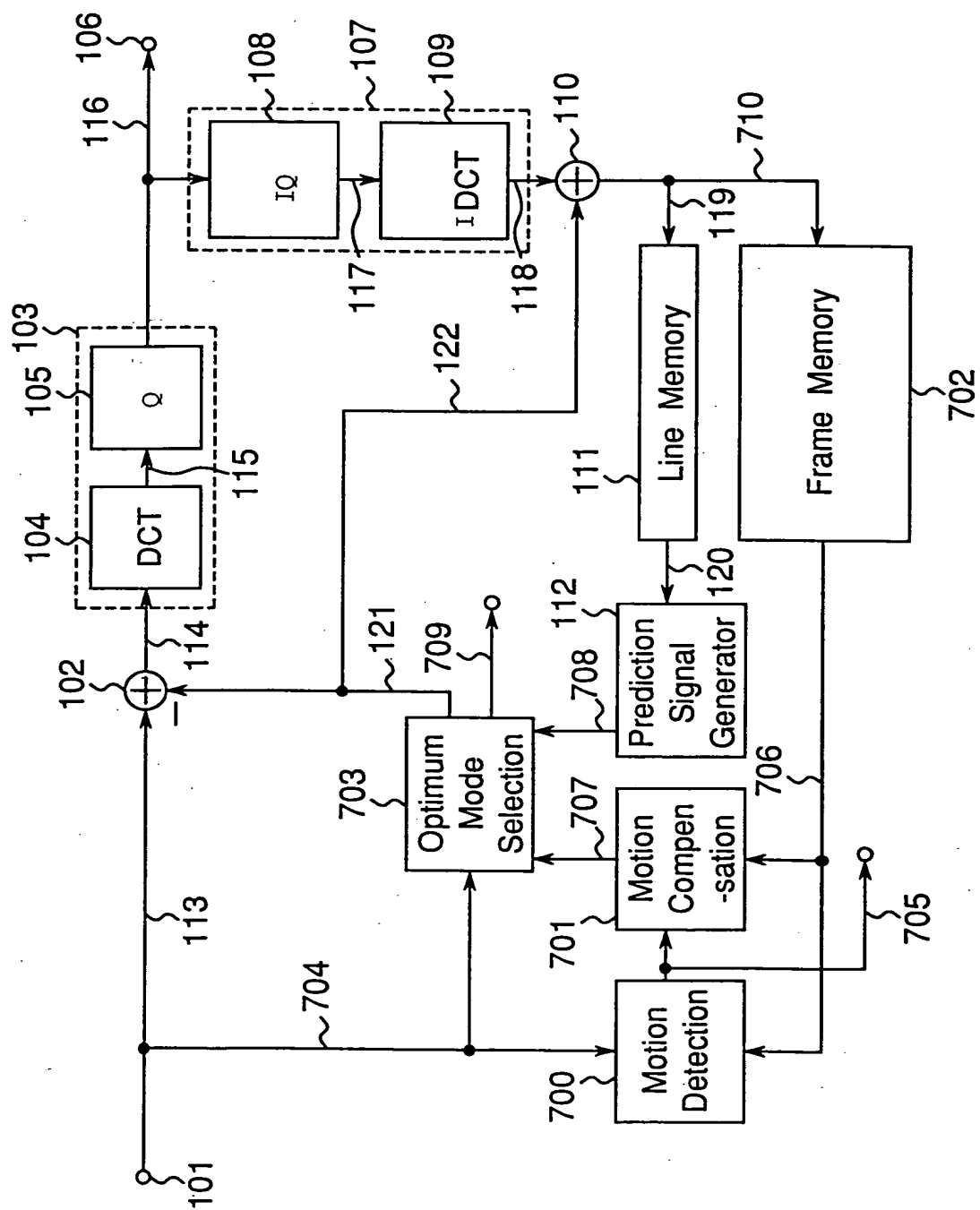


Fig. 8

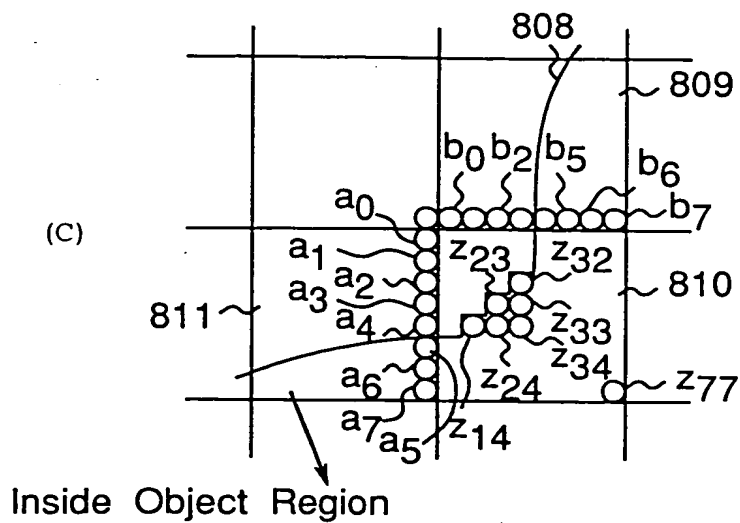
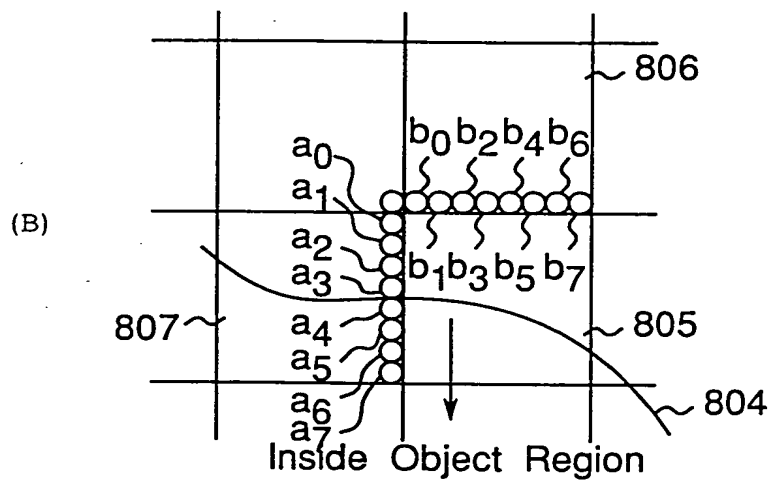
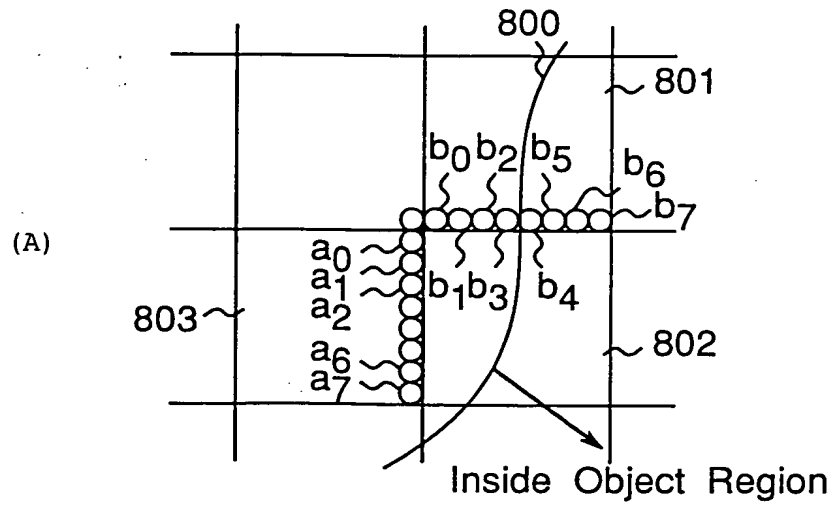


Fig. 9

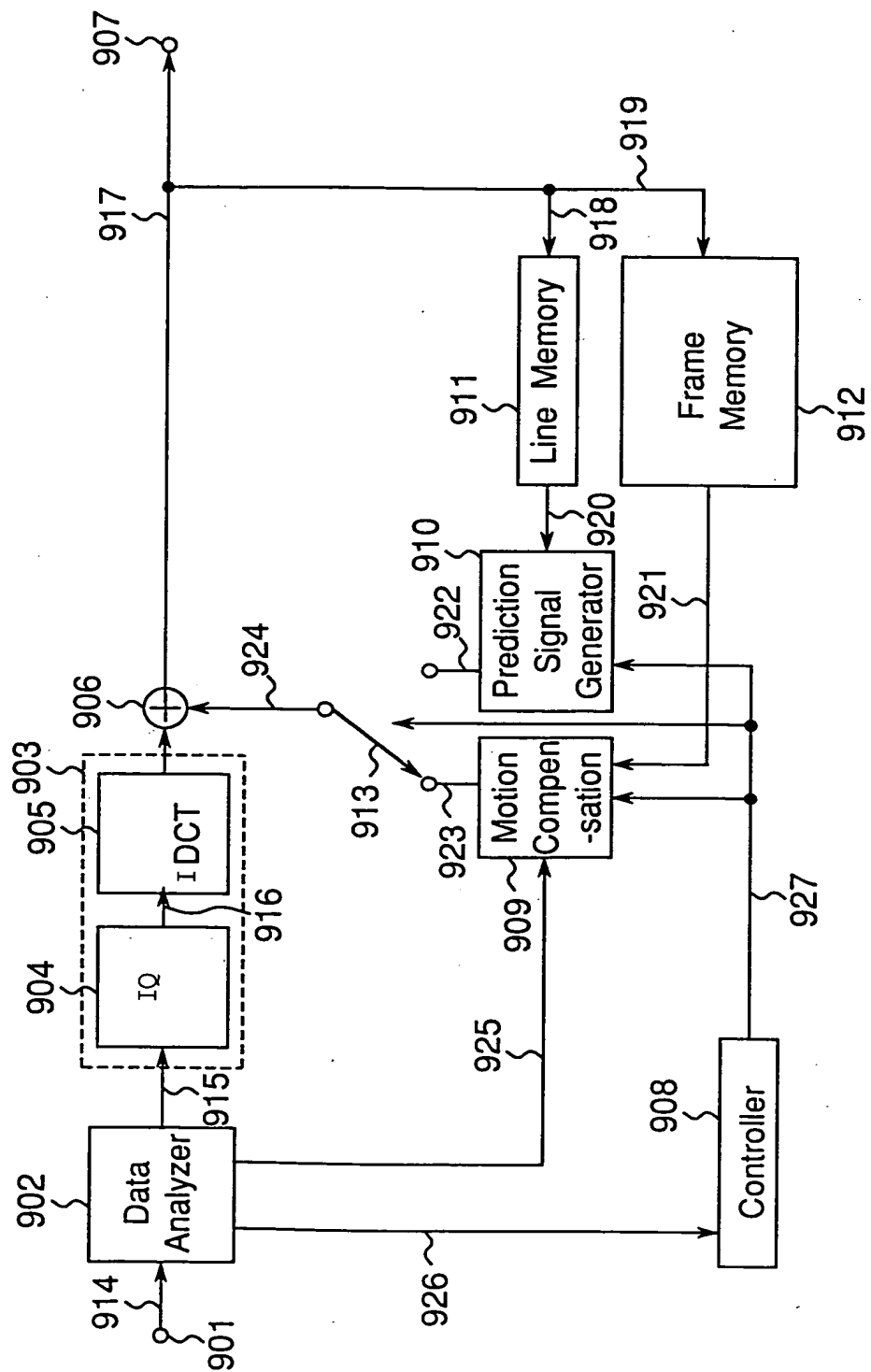
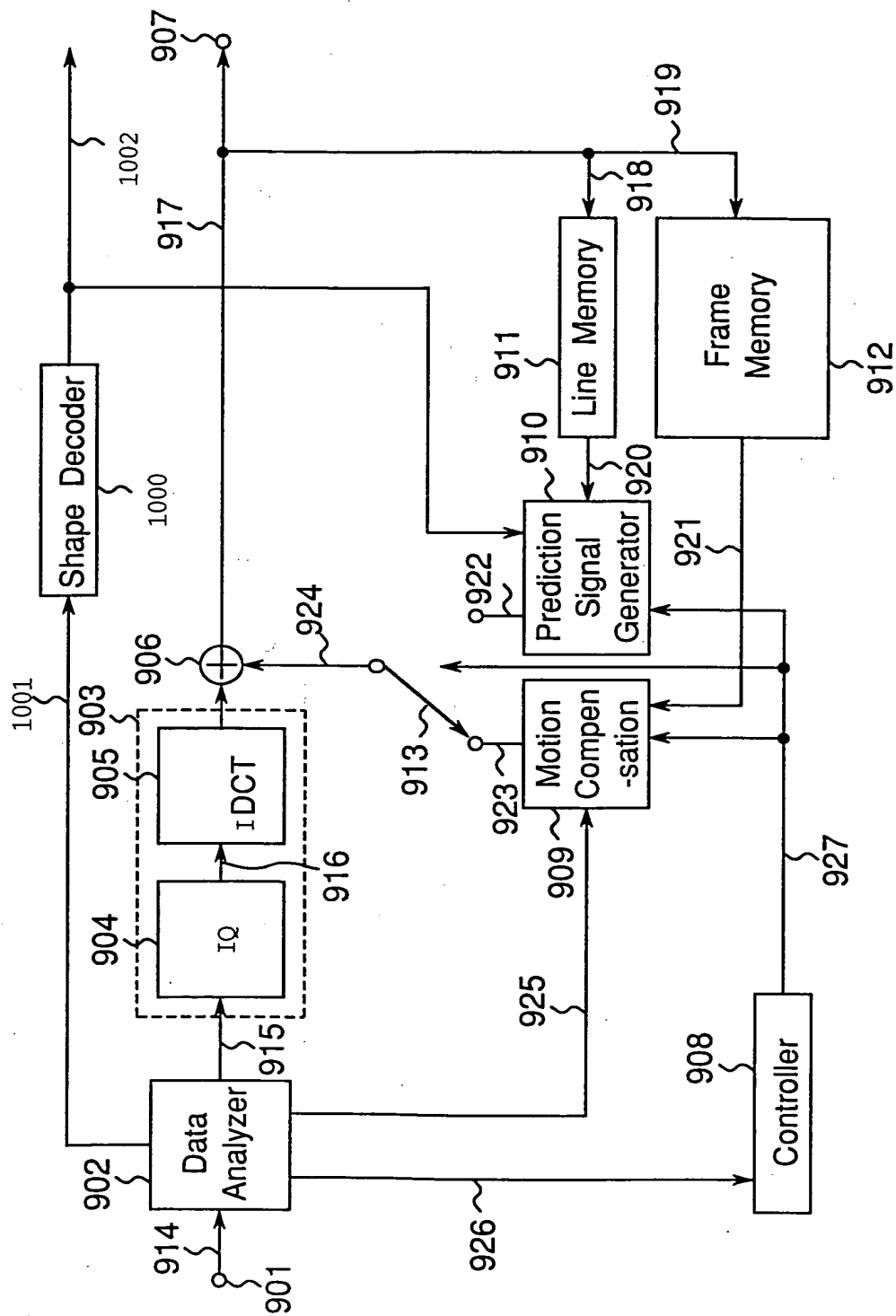


Fig. 10



Document Name: Abstract

Abstract:

(Object) It is necessary to generate a prediction signal of a spatial region simply with high precision.

5 Coding and decoding apparatus are required to be capable of high-speed operation.

(Solution) In a process of dividing the image to be coded into a plurality of adjacent small regions and coding a target small region among the plurality of adjacent small regions, the apparatus uses reproduced pixel values adjacent to the target small region as pixel values of an intra-frame prediction small region of the target small region, uses the intra-frame prediction small region as an optimum prediction small region, generates a difference small region from the target small region as well, encodes the difference small region, after these steps, decodes the coded difference small region, adds the decoded difference small region to the optimum prediction small region, and generates and stores a reproduced small region.

20 Selected Figure: Fig. 1

Document Name: Official Correction Data

Corrected Document: Petition for Patent

<Approved or Supplemented Data>

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1. Date of Registration: August 28, 1990

Reason of change: newly recorded

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